CURRENT SCIENCE

Volume 74 Number 5 10 March 1998

CORRESPONDENCE

Decline in research in Indian universities

Sushil Kumar *et al.* (*Curr. Sci.* 1998, **74**, 20–24) have made a shocking revelation about the decline in the frontline research activity in the Indian universities. I have highlighted the dismal state of affairs in my article 'What ails Indian Science' submitted to *Current Science*. Being associated with CSIR during 1990–95 as an expert on Physics panel for selection of SRFs and RAs, I fully endorse the conclusions drawn by the authors based on the available database.

It is surprising that while the number of NET-qualified candidates has increased steadily by 5.2% in 1995–96 over the figures of 1991–92, there is an overall steady decline in the number of candidates opting for research career in science and technology. The figures are mind-boggling, i.e. 54% drop in interest of post-graduates for doctoral studies in physical sciences and 28% in medicine and engineering during the same period. The worst hit is the discipline of earth sciences where the decline of interest is sudden and frightening.

The authors have analysed the reasons for the decline of interest in scientific research among the young graduates in India due to (i) scarcity of job opportunities in the universities and research organizations, and (ii) liberalization of Indian economy, creating more avenues of employment in trade and marketing sectors.

What strategies should be evolved to stem this decline? The authors leave this question open for discussion. I wonder why this problem has not rattled the brains of big-wigs of Indian science! Abdus Salam, Nobel Laureate, has analysed this problem of India and Pakistan in his book *Ideals and Realities* (World Scientific, 1995) as follows: (i) The very poor quality of science education at all levels, (ii) higher grades and better facilities for civil service (IAS) bureaucrats, and (iii) the tradition of building advanced centres of research outside the university system.

In our own university, during the last fifteen years the strength of science faculty has increased three-fold but the per capita research output has dropped to one third of its level in 1982. The quality of research has deteriorated as there are no incentives for research. Due to sudden expansion in the university, the number of science departments has grown from 4 to 16 during the last 15 years, the infrastructure facilities have decreased drastically. There is a wide disparity between the grades of research staff and the teaching faculty. A NET-qualified lecturer gets nearly three times more salary than a JRF with the same qualification. Hence most of the NET-qualified candidates opt out of the research stream. All our toppers in M Sc either compete for the most coveted IAS examination or seek admission to MBA or MCA professional courses for better job opportunities.

In my view, this down-hill slide will continue in future and the 'Vision India 2020' projected by A. P. J. Abdul Kalam (*The Tribune*, Chandigarh, 23 February 1998) will get distorted unless our science planners review the situation in light of the facts presented by the authors.

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NEWS

Science Congress 1997–98

Come January, scientists of India assemble for the annual meet of the Indian Science Congress Association (ISCA), never mind if some of them decry it and even suggest scrapping it. Over the years, the Congress has acquired the unenviable reputation of a 'mela', and it was time someone took it upon oneself to regain for the Congress its original purpose of a meeting where current developments are discussed in an interdisciplinary setting and a forum is provided for evolving policy directions. In all fairness, I must say that P. Rama Rao, the general president of ISCA, has tried his best to do just that.

The 85th session of ISCA, held at the sprawling campus of the Osmania University, Hyderabad, during 3–7 January was attended by about 3700 Indian and 75 foreign delegates. Among those attending the congress were an amateur inventor from Pune who seems to have met a number of scientific celebrities, a

businessman-cum-water diviner, many retired scientists including Fellows of Academies and former vice chancellors and close to fifty officials from different scientific departments in Delhi. However, participation by the private sector industry, as pointed out by Ashok Ganguly, Chairman of ICI Limited, was rather meagre. May be the Indian industry continues to perceive scientific research as a peripheral activity of not much consequence to them.

There were seven plenary sessions, sixteen sections, two committees and six fora, a special session on science for schools and an exhibition for children. To cap it all, there was a public lecture by Roald Hoffmann, the Nobel prize-winning chemist from Cornell University. Not only were the plenary sessions held at the Tagore Auditorium well attended, despite occasional power failure and poor audiovisual support but many sectional sessions also attracted much larger audiences than regular attendees of Science Congress meetings had seen before. Perhaps, because the sessions were not crowded, and only a few speakers were invited to make presentations in each session and each speaker was given a respectable 15–20 minutes. The content of the programmes was generally perceived to be of a higher standard than the usual Science Congress fare.

Inaugurating the Congress, Prime Minister Inder Kumar Gujral said that both his happiest and saddest moments as Prime Minister were to do with science and technology. He was happiest when he saw the launching of a satellite by our space scientists. He was saddest when a village in Rajasthan invited him to thank him for providing drinking water after fifty years of independence. He drew attention to the achievements and lacunae in Indian science. On the one hand, we have some outstanding achievements in space research, missile technology, agriculture and nuclear energy, and on the other we have not been able to tackle such basic problems as public hygiene and provision of drinking water to all our people. He wanted the scientists to help the nation tackle the problems of illiteracy, power generation, and creation of scientific temper among the people. He wanted the message of science to be spread, right from the primary school level and up to the level of politicians, policy makers and administrators. He wanted Indian scientists to take interest in patenting and Intellectual Property Rights, and urged them to go beyond import substitution and be truly innovative and help forge links between academia and national laboratories on the one hand and the industry on the other. The Prime Minister asserted with pride that whenever some foreign countries mounted pressure on India, we have converted every denial into an opportunity. Super computers and the cryogenic engine are two examples where indigenous efforts succeeded when overseas help was denied. Among the suggestions he offered are the revival of the science talent search scheme and the institution of a new award to recognize those who promote scientific temper among the people.

How much are we investing in science?

The inaugural day saw the dignitaries airing views contradicting one another. Yoginder Alagh, Minister of State for Science and Technology (as well as Power) said that science in India was doing well 'by any serious standard', that, contrary to what was generally believed, Indian industry was spending 1.26% of industrial GDP, and that the share of citations to Indian work was not going down as was widely believed. He quoted some recent preliminary studies based on data collected by the Reserve Bank of India to substantiate his figure for the amount spent on R&D by the Indian industry, and some undisclosed studies to support his claim that Indian scientific papers were cited more often than were normally credited. He said that we had so far neglected the contribution made to R&D by small enterprises in the country, which for some reason were not registered with the Department of Scientific and Industrial Research as a SIRO (scientific and industrial research organization). Even larger enterprises, he said, no longer felt the necessity to register with the DSIR, as liberalization had brought much of the benefits even without such registration. Alagh said that recent studies had shown that R&D intensity is much higher in some small industries than in large industries.

P. Rama Rao, former Secretary of the Department of Science and Technology and this year's general president of the Indian Science Congress Association, was the first to differ with Alagh. In his presidential address, Rama Rao drew attention to the decline in the investment on science and technology (in terms of percent GNP), and said that sub-critical investment had led to the funds being spread too thin on too many projects in a large number of institutions. According to him, 67% of the Rs 360 million invested on science in the Eighth Plan came from the central Government, and 24% from the industry. Stating that India invests annually about $2.5 billion, compared to $500 billion worldwide, and that only 15% of this meagre investment goes to support basic research, Rama Rao said that return on investment on science was much higher than in other fields of productive activity. He pleaded for continued support for basic research and a rapid rise in the investment on science and technology to 2% of GNP by the end of the 9th Plan.

C. N. R. Rao, Chairman of the Scientific Advisory Committee to the Cabinet, was the next to differ with Alagh. He was clear in his mind that funding for scientific research was inadequate and that Indian scientists were finding it increasingly difficult to publish their work in reputed journals of the world, especially in the experimental sciences. Nor were they filing a large number of patents. In his view, the gap between the advanced countries of the West and India in science and technology was increasing rapidly, and the visibility of Indian science was rather low. He asked, 'How did we fail to motivate the young and attract them to research and how did we fail to persuade industry to support science?' He wanted science and higher education to be recognized as a basic necessity and a minimum requirement. He warned that if we did not save science in India now, it would be wiped out. The government should support both science and education, he said. He was also critical of setting up more and more engineering colleges, as we would not be able to absorb all the graduates. He was greatly concerned about the lack of the right kind of role models for our youngsters and the bickering among scientists. Dedication and generosity were in short supply in Indian science, he lamented. 'Stop harassing each other,' he advised Indian scientists, and 'learn to distinguish between frontline science and routine work'. He blamed the crisis in leadership. And

most of the leaders of Indian science were there at the Congress.

Speaking on science and scientists in the 21st century, C. K. N. Patel, Vice Chancellor of Research, University of California, Los Angeles, was even more critical of science in India. Invited by Mrs Indira Gandhi once, he recommended closing down most of the national laboratories as they had outlived their usefulness. Of course, his advice was ignored, and he was not invited again, he said. He blamed lack of vision and lack of sharp focus for India's inability to generate knowledge that could be converted into wealth. Random walking on the roads of research would not do. 'Individually you may find some good scientists but collectively you are nowhere on the global scenario,' he continued. There have been no major breakthroughs from India. In physics, for example, he said, he rarely sees papers from India in *Physical Review Letters*, whereas Chinese scientists account for one third of the papers published in that journal. A quick check showed that Chinese scientists did not publish that many papers, but Patel had a point.

Speaking on wealth creation and industrial R&D, Ashok Ganguly, Chairman, ICI Limited, said that the quality of public S&T had eroded because of increase in numbers beyond imagination, shortage of funds and preoccupation with import substitution, and that with a few exceptions, its wealth creation capacity had virtually disappeared. He felt that time was overdue to find ways and means to modernize both the people and the institutions in the S&T sector. He pleaded for a grand alliance between academic research and industrial R&D. He deplored Indian industry's reluctance to invest in R&D and said that if it had to remain competitive it could do so only through superior S&T-driven innovations. Unfortunately, real change was not happening, he lamented. He also called for greater thrust towards agricultural R&D, as it would be critical for the country's sustainable development. His message: Invest and invest even more massively in S&T institutions, industrial and agricultural R&D to generate wealth, the only weapon to banish poverty and illiteracy, he said. Stating that both demand and curiosity-driven research was necessary and that one without the other would be much less valuable as the former led to wealth creation and the latter led to production of new knowledge, he said that much of the responsibility for research lies with the Indian industry and not the government.

Maybe Alagh, the scholar and economist, should publish a detailed article in a refereed professional journal, substantiating his claims*. That after so many years of planned scientific activity, we are not even sure of how much we spend on science, and how well our work is recognized is a matter for concern. Surprisingly, my suggestion to set up an Observatory for Science and Technology in India, to provide such indicators on a regular basis, was turned down last year by more than one department of the government.

Indo-US collaboration

Another theme that was discussed at the Congress was international collaboration, especially Indo-US collaboration in science and technology. Tracing the transformation of science from pre-World War era to the post-cold war era, C. K. N. Patel said internationalization of science had come to stay and defence research had been put on the back burner. Marcia Greenwood, incoming President of the American Association for the Advancement of Science and a member of the US National Board of Science, was unhappy about the dwindling budget for joint Indo-US projects. The US–India rupee funds, which supported an active research programme in India, had come to an end in early January. Consequently, from now on the National Science Foundation has to rely on agreements with the Department of Science and Technology. Greenwood, currently chancellor of the University of California at Santa Cruz, felt that Indo-US collaboration in science was mutually beneficial, especially in fields such as high energy physics, astrophysics, mathematics, materials science and engineering, biotechnology and agriculture. She said that nationalist politics should not be allowed to affect international collaboration in science and pleaded for delinking politics from science. Problems such as infectious diseases, greenhouse emissions and sea level rise require cooperative research and sharing of results by scientists of different countries. Her own university, she said, was forging a unique link with India in the form of academic interchange and collaboration with leading Indian institutions such as the Tata Institute of Fundamental Research, University of Hyderabad, Calcutta University, and the National Institute of Advanced Studies. Asserting that knowledge was the key to the future, Greenwood suggested that science in the national interest requires a national interest in science. Despite the long history of leading in science, the United States would find it difficult to maintain the lead if growth in R&D funding would not keep pace with inflation, she said. According to her, if federal science policy is the engine and education and advocacy are the long-term source of energy, then partnerships and collaboration are the vehicles for progress in science. She urged scientists in both countries to persuade the legislators and bureaucrats in Washington and Delhi to vote continuity and stable growth for science investments.

The Chairman of the US House of Representatives Committee on Science, James Sensenbrenner, known to be a conservative Republican, urged that science should not be made a handmaiden of foreign policy goals. We cannot risk making scientific cooperation vulnerable to accusations that it is just another type of foreign aid. After all, he said, foreign aid continued to be unpopular with the tax paying public and linking it to funding for science would not advance the cause of science. He was critical of the $400 million Shuttle–Mir partnership. It was established in the wrong way for the wrong reasons. The Shuttle–Mir partnership was arranged by the Clinton administration to augment the US–Russian foreign policy more than for the science that could be achieved, he said. Widely believed to have been established as a sop to Russia to compensate for its loss of revenue resulting from the cancellation of the sale of rocket technology to India in 1994, the partnership only led to breaking of promises by Russia and to reduction of funding for other important science programmes in the United States to pay for the cost over-runs in the Russian space programme. Stating that increasing costs of cutting edge science required cost sharing by all participating countries, he emphasized that it was imperative for

*Alagh has published a paper in a recent issue of *Economic and Political Weekly* on R&D investment in India.

all partners in international ventures to be vigilant and to protect their own interests. He cited the example of the large hadron collider project located in Geneva, in which more than 20 countries including the US and India were partners, and narrated the steps taken to ensure non-European interests. He was confident that the new agreement between India and the United States, signed in the last week of December 1997 in Washington, would be a model for the future. Incidentally, even science policy specialists of NISTADS and the Jawaharlal Nehru University had not heard of this agreement till they heard it from Sensenbrenner! So much for our government's transparency and keenness to disseminate information.

Other plenary and special lectures

There were many other plenary and special lectures. Most of them were well attended. In fact, the hall was overflowing to hear Nobel Laureate Roald Hoffmann and Kalinga Prize winner Jayant Narlikar. Unfazed by frequent power failure and the poor public address system, Hoffmann used his public lecture on molecular beauty to demonstrate to the audience the underlying unity that unifies science and art – art including aesthetics, poetry, architecture and music. Giving several examples from India, he left no one in doubt that he was a good friend of India. Defining chemistry as the study of substances and their transformation, he went on to show how symmetry and repetition of patterns underlie all that is beautiful – be it a simple molecule or the most beautiful structure. Taj Mahal is a magnificent monument not because it is just beautiful. In fact, it is a paradigm of nature; a microcosm of nature's symmetry. It is a systematic repetition of its sample molecule. For him the spectral lines of a molecule are their musical notes. He emphasized the virtue of humility and urged scientists to work in tandem with nature. He admonished scientists not to lose the 'moral sense' and exhorted them to serve the people first.

Delivering the C. V. Raman Birth Centenary Award Lecture, Jayant Narlikar made a lucid presentation of current puzzles in cosmology and left no one in doubt why he was rated high as a science communicator. According to him, no model has given complete answers to both the origin of the universe and the direction it is taking. The dark matter and the concept of creation of new matter in the galaxies, both proposed to explain the hydrogen clouds in the outer periphery of a galaxy moving faster than the laws of motion and gravity would allow, were again not fool proof, he said. Other puzzles include cosmic antigravity and the age of the galaxy itself.

M. G. K. Menon recalled the great achievements of Indian scientists of an earlier generation – men like Raman, Saha, J. C. Bose, and S. N. Bose, who were gentlemen amateurs endowed with deep motivation and a profound sense of curiosity about nature. He said that since Independence, society had gone through major transformations and science and technology in India had grown tremendously. Emphasizing the need for India to set her own agenda for science and development based on technological competence and self-reliance, Menon wanted Indian scientists to abandon any sense of defeatism and start with a new sense of confidence. At the same time, he said Indian science should avoid living in isolation. Emphasizing the need for blending the modern with the traditional, Menon suggested the need to take advantage of Internet and other information infrastructures and biotechnology. He suggested a change in the organizational structure of science and technology in India; the departments, councils and commissions should yield their place to a networked infrastructure.

Talking on agricultural science and technology in India, M. S. Swaminathan said that we need more science, both in the public and private sectors, related to agriculture, if we are to falsify neo-Malthusian predictions of widespread food and drinking water insecurity. He was greatly concerned about the erosion of the ecological foundations – soil, water, forests and biodiversity – essential for sustainable advances in farm productivity, and the paucity of major technological innovations to fight the 'fatigue of the green revolution'. In order to reach the unreached, Swaminathan suggested that attention be paid to on-farm and off-farm employment generation, increasing investment in rural infrastructure, and harnessing information technology to provide timely information relating to meteorology, management and marketing. A combination of science, education and social mobilization, Swaminathan pointed out, could help convert green revolution into an evergreen revolution.

The talk by W. Keifer on the impact of Raman spectroscopy and that by David Cox on statistics in science and technology were truly professional. David explained how statistics plays an important role in science today, giving examples from physical, biological and social sciences. Keifer showed how the simple technique invented by C. V. Raman had evolved, thanks to advances in optics and instrumentation, into one of the most potent tools in modern science with applications in art, archaeology, biology and medicine. He showed pictures of the complex array of equipment in his laboratory costing millions of dollars, a far cry from the pioneering experimental setup of Raman, and gave examples of problems where Raman spectroscopy is playing a key role, such as identification of pigments on medieval manuscripts and identification of alkaloids in plants. Both these talks demonstrated the awesome power of tools and techniques, conceptual and physical, to solve problems in a wide variety of fields. The presidential address in the mathematics section (by Karmeshu) was of the same genre too. Karmeshu demonstrated how quantitative techniques of physical and mathematical sciences such as modeling, nonlinear and stochastic equations and self-organization could be applied to the study of complex social, economic, political and biological systems. Among the diverse topics he dealt with are diffusion of innovations, information diffusion, competing social groups, technological evolution, urbanization, migration, queuing in random environment, machine interference, traffic flow, hydrological systems, and seismic excitation. Incidentally, the mathematics section was perhaps one of the best organized in this year's Science Congress.

M. S. Valiathan, Vice Chancellor of the Manipal Academy of Higher Education, spoke about endomiocardial fibrosis, a mysterious disease afflicting children in Kerala and other coastal areas close to the equator. The disease is characterized by sudden ballooning of the heart due to the formation of thick fibres inside the heart ventricle affecting pumping of blood. He presented evidence to show that cerium, a toxic rare earth element present in the monozite sands, was responsible for this debilitating heart disease

which kills children within six years of onset. This again was a report of an interdisciplinary study involving cardiologists of the Sree Chitra Tirunal Institute of Medical Sciences and Technology, and mapping of the cerium mineralization by the Bhabha Atomic Research Centre, geologists and oceanographers.

G. Padmanaban, Director, Indian Institute of Science, spoke about the ethics of gene cloning and Nitya Nand traced drug discovery research in India. T. R. Anantharaman spoke on his favourite theme, science, spirituality and society, and R. C. Mehrotra presented a paper on the chemistry and technology of M–O–C derivatives.

Theme sessions

Three plenary sessions were devoted to specific themes, viz. energy options, information technology and ecology and environment. The panel on energy options was heavily overloaded with advocates of nuclear power chairing the session on energy options. R. Chidambaram, Chairman of the Atomic Energy Commission, said that both nuclear and renewable energy sources should be exploited. Morris Rosen, Advisor for environmental matters at the International Atomic Energy Agency in Vienna, painted a rosy picture of the nuclear energy option. He cited the extraordinarily high energy density of nuclear fuel, low risk, low levels of spent fuel that can be safely disposed, and low levels of pollution as reasons for his preference. From the point of view of environment, he said that nuclear energy was far superior to coal and other fossil fuels and solar photovoltaic cells (because of the release of greenhouse gases during the manufacture of silicon chips). Ch Surendra of the Nuclear Power Corporation of India pleaded for the establishment of more nuclear power plants, as they would not contribute to global warming and acid rain and their unit energy cost would be favourable. H. S. Mukunda of the Indian Institute of Science argued in favour of renewable energy sources, especially bio-residues, for they would help provide decentralized production of electricity, avoiding the grid approach which has not yielded satisfactory results. Also, low power levels of these plants would mean lesser capital requirement, making it easy for private investors. Bhakta Rath of the U.S. Naval Research Laboratory spoke about a source not so well known in India, viz. gas hydrates which occur as crystalline solids on ocean beds. These clathrates are essentially methane gas surrounded by a cage of water molecules. His laboratory, he said, had entered into an R&D collaboration with the Gas Authority of India to explore the possibility of using this methane deposit as a source of energy. Satish Chandran, formerly principal secretary to the prime minister, said that despite attempts to woo private investors, public funding of power projects should continue for a long time to come. It was necessary to ensure a rapid increase in power production needed to sustain a 7–8% annual growth of GDP.

A. V. Gokak, Chairman of the Telecommunication Commission, said that plans were afoot to ensure the availability of telephone connections on demand by the year 2002. Elaborating on the plans for the Ninth Plan and beyond, he said that the thrust areas included replacing manual exchanges with computerized digital exchanges, modernization of customer services, setting up high quality backbone network for information superhighway and laying of fibre optic cables and microwave systems. He called upon researchers to concentrate on developing rural networks and to strengthen the indigenous research base. Stating that the biggest challenge before the scientific community was to make communication technology affordable as well as accessible to all the people, Ashok Jhunjhunwala went on to explain the salient features of the work on low-cost telephone exchange carried out in his own laboratory at the Indian Institute of Technology, Chennai. Incidentally, the CorDect wireless local loop system developed by his group is already in use in many countries including China and Brazil. Mark Hill of the University of Wisconsin at Madison cautioned that in countries like India the differences between the information haves and have nots could exacerbate the already existing social tensions. Asish Arora of Carnegie Mellon University drew attention to the rapid erosion of the cost advantage India enjoyed in software development. V. S. Arunachalam, formerly Scientific Advisor to the Ministry of Defence, emphasized the need to concentrate on parallel computing and networking. Raj Reddy of Carnegie Mellon University spoke about the immense potential of digital libraries and electronic commerce. He predicted the advent of Giga PCs within two years and systems that would never fail. N. Balakrishnan of the Indian Institute of Science also spoke, in another session, about digital libraries and information superhighway in the Indian context.

Speaking on the session on ecology and environment, Raghavendra Gadagkar of the Indian Institute of Science stressed the need for identifying the tens of thousands of insect species found in the subcontinent. He felt that biological research in India is heavily tilted in favour of cellular and molecular biology and urged taxonomists and entomologists to contribute to the study of insect biodiversity. Jayanta Bandyopadhyay, noted environmentalist, urged scientists to take a holistic and interdisciplinary view of sustainable development of the mountains, as mountains form a substantial fraction of terrestrial surface and provide close to two thirds of freshwater used. A. T. Natarajan spoke on cytogenetic mapping of chromosomal damage to human populations exposed to ionizing radiation, and A. Peerally of Mauritius discussed the environmental and ecological issues relevant to the quality of life in the developing regions.

Beyond the sessions

The Swarna Bharati Science and Technology Exhibition organized as part of the Congress was well attended. Thousands of school children saw the exhibits. The section on Mathematics in the Modern World put up by the St Stephen College, Delhi, was a star attraction. It succeeded to a large extent in explaining to the people the practical applications of mathematics in physics, finance and stock markets, music, etc. The Homi Bhabha Centre for Science Education had put up an exhibition entitled 'Science: A human saga' at the Tagore auditorium, the venue of the plenary sessions.

There was a meeting of the International Federation of Associations for the Advancement of Science and Technology (IFAAST), rather poorly organized. The saving grace was an outstanding talk by Roald Hoffmann.

There was a media centre with moderate facilities and helpful staff led by Usha Vyasulu Reddy. But often they could not procure texts of talks presented at various

venues. They brought out a conference daily called *Scan '98*, largely produced by students of the Osmania University Department of Journalism.

Some critical observations

In the past few years, the character of the annual meeting of the Science Congress Association has changed. The leadership has passed on from academics – university professors – to bureaucrats. Look at the general presidents of ISCA. Last year it was S. K. Joshi, formerly Director General of CSIR and Secretary, DSIR. This time around it was P. Rama Rao, former Secretary, DST, and currently Chairman, Atomic Energy Regulatory Board. Next year it will be Manju Sharma, Secretary, DBT. The year after it will be R. A. Mashelkar, Secretary, DSIR. Is it all for the good, asked a delegate from Delhi. Our universities are downgraded not only from outside but also from within the scientific and scholarly community, he opined. Could it be because bureaucrats are in a position to fund such associations and meetings and laboratory scientists, however competent they may be in their work, have to depend on the bureaucrats for their survival? Also look at the awardees in this year's Science Congress. There were thirteen of them including those who received the five newly instituted awards. Asked A. Mahadevan, who spoke in the Botany Section on the last day, why was it that we kept on speaking of encouraging young scientists if the major awards of the country had to go to the same set of people. This question was also raised by reporters covering the Congress. Aren't we giving the impression to the large number of young research scholars attending the conference that one has to be a science administrator to win an award or be elected general president of ISCA? This year's award winners included – you wouldn't get a prize for guessing it right – M. G. K. Menon and Yash Pal, both of whom delivered lectures without a prepared text. Neither the organizers nor the media centre could provide a summary of their talks let alone the full text versions. If scientists want their views – especially about dwindling support – to be heard and acted upon, they should take such meetings seriously. Perhaps, the ISCA general president should insist on the submission of the text well in advance.

Several speakers touched upon the important issue of the exodus of the youth away from science not only to careers in engineering and medicine but also to management and marketing. It is clear that science education is being neglected and that science is no longer an attractive career option. The exodus is not restricted to the entry level. A substantial number of scientists, it was pointed out, were leaving the Departments of Space, Atomic Energy, Defence and CSIR for lucrative jobs in the globalized private sector. P. N. Tandon, the eminent neurosurgeon and former president of INSA, asked scientists to stop deserting the ship (of science in India) and sailing abroad. He urged young scientists to stay back, work on problems relevant to India and pursue excellence. But the Government is seriously considering to treat higher education as a non-merit good!

There were many disruptions caused by power failure. The first technical session on the second day of the conference, when the presidents of different sections were to deliver their presidential addresses, was delayed by nearly an hour. When Roald Hoffmann, the star attraction at the meeting, was delivering his special lecture on molecular beauty there were many disruptions to the great discomfiture of the organizers. The Andhra Pradesh Government had given Rs 10 million to the Osmania University but the entire sum seems to have been spent on giving a facelift to the campus. A part of it could have been used to improve the infrastructure.

These shortcomings notwithstanding, one got the feeling that efforts were afoot to change the perception that the annual meeting was a mela. Will the Madras session be better than the one at Hyderabad?

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RESEARCH NEWS

Green fluorescent protein: A novel reporter gene

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Plant transformation systems involve the stable insertion of the functional DNA directly into the genome of plant cells and their regeneration into transgenic plants. During the last decade, a wide range of methods and different approaches have been used to produce transgenic plants with many desirable traits in many important crop plants and some of them are moving to market for the end-users[1]. However, the main bottleneck in transgenic research is the low efficiency of stable gene transfer. The success of any transformation experiment depends upon the selection of the transformed cells, which are limited in number, from the whole plant tissue. To increase the frequency of transformed cells, it is essential to standardize all the factors (depending on the gene transfer technique used) using transient expression of reporter genes whose expression can be measured visually or biochemically and then to carry out transformation experiments using these optimized parameters. A large number of reporter genes are presently available. Among them, the most widely used is the *gus* reporter gene system and others are *luc*, *cat* and anthocyanins. These reporter genes suffer from various